River Road Bridge
Spanning the Missisquoi River
on River Road (Town Highway 22),
approximately 0.76 miles north
of the intersection of Vermont Route 100
and Town Highway 22
Troy
Orleans County
Vermont

HAER No. VT-15

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Mid-Atlantic Regional Office
National Park Service
U. S. Department of the Interior
Philadelphia, Pennsylvania 19106

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HISTORIC AMERICAN ENGINEERING RECORD

River Road Bridge

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Location:	Spanning the Missisquoi River on River Road (Town Highway 22), approximately 0.76 miles north of the intersection of Vermont Route 100 and Town Highway 22, Troy, Orleans County, Vermont UTM: 18.705525.4976725 Quad: Irasburg
Date of Construction:	1928
Engineer:	Berlin Construction Company, Berlin, Connecticut
Present Owner:	Town of York, Vermont
Present Use:	Vehicular bridge
Significance:	The bridge is significant as a representative example of the type of bridges built following the flood of 1927, in which over 1,250 bridges in Vermont were destroyed. The flood was a major episode in Vermont's twentieth century history. The resulting engineering effort included the extensive use of standardized design and economical contribution by which the State was able to rebuild a large number of bridges very quickly. The Berlin Construction Company was one of two major providers of flood-era bridges. This bridge is eligible for inclusion on the National Register of Historic Places.
Project Information:	This documentation was undertaken in October and November 1989, in accordance with a Memorandum of Agreement signed by the Federal Highway Administration, the Vermont State Historic Preservation Office, and the Advisory Council on Historic Preservation (ACHP). The Memorandum of Agreement has been accepted by the ACHP as a mitigative measure prior to replacement of the bridge in 1990.
Prepared by:	Alison B. Church Project Engineer Location & Environmental Studies Section Vermont Agency of Transportation Montpelier, Vermont

1. Site Features and Historical Background

This bridge is located over the Missisquoi River in the western part of the Town of Troy, Vermont, approximately 12 miles below the river's headwaters along the east side of the Green Mountain Range on Belvidere Mountain and Mount Norris in the Town of Lowell. The Missisquoi River flows north into Canada's province of Quebec. The river returns, by combinations of westerly and southwesterly flow around the limits of the Green Mountain range to Vermont and ends in the Missisquoi Bay of Lake Champlain. Lake Champlain drains north via the St. Lawrence River in Quebec, which in turn flows east to the Gulf of St. Lawrence and the Atlantic Ocean.

Initially a hunting ground for settlers from older communities in the region, the area that eventually became the Town of Troy was not settled until 1797. The first Town Meeting was held in 1802. The name of the town at this time was Missisquoi which, in 1803 was changed to Troy. (1)

In this region, both the transportation network and the Missisquoi River are oriented north-south. Troy was linked in 1807 to Irasburg, the northern terminus of the Bayley Hazen Military Road constructed in 1779. The road constructed in 1807 extended from Irasburg through Troy to the Canadian Border. Goods such as wheat, potash, lumber, and cattle were exported to Canada through Troy on this road. (2)

By 1828, Troy had become an important link between Derby and Burlington, helping to provide the northeast region of the State easier access to the Champlain Valley. (3)

Troy has historically been an agricultural Town. In the 1820's, the main village, Troy Center, was established around what became known as Phelp's Falls. Phelp's Falls, formed by a dam, was the power source for an extensive mill complex. Grist, saw, and woolen mills were established, providing the backbone around which schools, stores, a boarding house, a post office, and residences were built into the 1860's. (4)

Knitting and woolen factories appeared briefly, tapping the power from Phelp's Falls. By 1870, the knitting and woolen industry began to shut down while the sawmill gained strength. In the 1870's, a veneering mill, blacksmith and tannery were added, solidifying the agricultural/mill complex. (5)

River Road, of which this bridge is a component, runs parallel and east of the Missisquoi River and historically carried the bulk of the traffic in this region. River Road bisected the mill complex. As illustrated in figure 1 (Appendix III), the bridge was the only means of access to the clapboard mill, dry house, veneering mill, tannery and sheds. (6)

Upon the introduction and incorporation of electric power at the turn of the century, the water-powered local industries became obsolete, as they lagged behind their competition in efficiency. These industries, including those at Phelp's Falls in Troy, were abandoned shortly after the turn of the century. In 1916, the mill complex at Phelp's Falls was shut down. (7)

2. Bridge Description

The bridge is a single span steel Warren pony truss. The 90 foot span is composed of 5 - 18 foot panels. Each panel is detailed as follows:

The top chords are 8" x 15" box girders with latticed undersides. The bottom chords are 4" x 8" channel girders with end panels comprised of two angles with stay plates approximately 40" apart. I-beam verticals and diagonals connect the top and bottom chords. The verticals serve as bracing for the triangular web structure, while the diagonals carry the tensile and compressive forces. (8)

The floor system is composed of I-beam stringers, I-section floor beams and angle section bottom cross bracing. The deck consists of 2" x 4" planks on end with runners. The bridge originally had wooden beam curbs on 4" spacers which, after deterioration with time, were not replaced. The bridge guide rail consists of two angle iron rails hooked to upper truss members. (9)

At the time of construction, connections were riveted. Upon deterioration, many of these rivets were replaced with bolts. End panels are inclined and the builder's plates are present on the upper truss members. (10)

The abutments are made of concrete. Three of the wingwalls are flared; one is oriented in the same direction as the abutment. (11)

The bridge is in very poor condition; and, though posted for eight tons, is only capable of safely supporting a live load of three tons, according to the State's Bridge Division. All wood, including runners, curbs, and plank decking has deteriorated extensively; some of the plank decking has been crushed, cracked or otherwise damaged to the point of failure. Likewise, the steel has been severely affected by time. Heavy rust scale is present in both upper and lower truss members; the ends of verticals and diagonals at each panel point; the bearings; the floor beams; and the stringers. Section loss has occured in the lower truss members; the floor beams; the stringers; the bolts, especially near the bottom chord; and the rivets, especially near panel points. Nearly half of the stringers are crushed to some extent suffering partial or complete failure. (12)

There is deep spalling in the concrete abutments, particularly in the vicinity of the bearings and along the bottoms, where there is also severe section loss. The right wingwall of Abutment 1 is cracked off vertically approximately 2 feet from the end of the abutment to a maximum width of a 2½". The end portion of the wingwall tips in toward the channel. (13)

4. Construction

In early November 1927, three days of heavy rain inundated the State, resulting in the Flood of 1927. Troy was severely hit, retaining only one intact bridge in North Troy. In the 1870's, there were two bridges in the area of the mill complex. Only one was rebuilt after the flood in conjunction with realignment of River Road. (14)

The Town of Troy, like many of the smaller towns, was reluctant to accept assistance from the State. However due to the extent of flood damage, Troy had no choice. In the Town of Troy, flood damage amounted to $127,000 overall including almost $10,000 for materials needed to reconstruct roads and bridges. On November 30, 1927, a special Legislative session was called to order by Governor John E. Weeks. At this session, the State assumed the responsibility for all road and bridge construction. Approximately $8 million of an $8.5 million bond issue was appropriated for highway and bridge construction to be supervised by the State Highway Board. To assist the State, the United States Congress appropriated $2.6 million. To receive the federal aid, the State had to delay repair work until passage of the aid bill in late May of 1928. (15)

With over 1,250 bridges totally destroyed or severely damaged by the flood, the State required mass production and installation of replacement bridges. The Warren pony truss was one of many bridges of standardized design implemented to facilitate mass production. The State's bridge engineer, A.D. Bishop, made the decision to use standardized design to deal with the given time constraints imposed by the flood. "It was.. realized that it would be impossible during the winter, so as to have them available in the early spring, to draw up plans covering all the bridges to be constructed this year. For this reason, it was decided to standardize all the work possible." (16)

The span length required at this location in Troy was less than 100 feet. A flood-era decision was made that for spans less than 100 feet, the Warren pony truss was the type of standardized bridge implemented. The Warren pony trusses in this era differed only in the configuration of the top chord. The bottom chord is horizontal throughout all configurations. Variations in the configuration of the top chord are as follows:

- Top chord horizontal (parallel to hottom chord)
- Curved (parabolic) top chord
- Polygonal top chord

Bridges in which the top and bottom chords are parallel, both horizontal, are the easiest and quickest to erect. However, these bridges are not as strong as those with configurations of curved top chord and those with polygonal top chord. With either a curved or a polygonal top chord, forces are directed through the top chord to the point of bearing. When the top and bottom chords are parallel, connected by diagonals and verticals, forces are transferred through the end diagonals to the point of bearing. These end diagonals are much less substantial than the top chord and are limited in load-carrying capability. (17)

With relatively light load requirements, this bridge in Troy was designed with parallel top and bottom chords and featured the use of time and expense saving I-beams in the verticals and diagonals. (18)

Due to the extent of the bridge replacement crisis, the Troy bridges were lumped together in the expense records of the Town. Since its construction in 1928, the bridge has heen repaired. Dates of repair to the bridge are unknown, but there is evidence of work done. Seven - 6½" x 12" I-beams have been added since the time of construction. Double wood heam supports with diagonal wood plank braces have been placed under more than half of the stringer ends at one of the abutments. Lastly, many deteriorated rivets have heen replaced with bolts. (19)

There were two fabrication companies that supplied the majority of Vermont's flood era bridges: the American Bridge Company and the Berlin Construction Company. The Berlin Construction Company was formed when three officers of the Berlin Iron Bridge Company, a Connecticut based firm, left the organization in response to the American Bridge Company's acquisition of the firm in 1900. When American Bridge Company acquired the Berlin Iron Bridge Company, the Connecticut factories were dismantled and the associated buildings were moved to a new plant in Pennsylvania. The three former officers of the Berlin Iron Bridge Company formed the Berlin Construction Company to satisfy the demand for subsequent building contracts in the Northeast. In 1902, the Berlin Construction Company built fabrication shops four miles from the site of the former Berlin Iron Bridge Company. (20)

4. Design and Technology

For the majority of steel bridges prior to the flood era, the structure consisted of built up members, characterized by plates, channels and angles riveted together. Though this bulkiness resulted

in very strong members, the process required extensive in shop assembly. The standardized bridges built after the flood featured built-up members only for the top and bottom chords, with rolled I-beams for the vertical and diagonal members to connect the top and bottom chords. The use of I-beams for those members minimized the time required for assembly, thereby expediting the process of replacing the bridges. (21)

The only limiting restraint imposed by the use of standardized design was in alignment. Structures of this type required a crossing nearly perpendicular to the feature crossed. Restrictions on the skew angle resulted in roadway approaches with very tight curves, a less than desirable horizontal alignment. (22)

Standardization, as exemplified by the Troy bridge, was initiated in the 1910's but was not used on a widespread basis. Therefore, the significance of this bridge, as well as other standardized bridges of the era is that through the large scale use of these bridges after the flood, Vermont helped set the precedent in the bridge construction industry of utilizing rolled beams in trusses with standardized chords. (23)

FOOTNOTES

1. Peter Thomas et al., "Phase I Archaeological Assessment for the Missisquoi Hydroelectric Project", (Report No. 34 from University of Vermont, Department of Anthropology, Burlington, VT, 1981), p. 92.

2. Thomas, p. 93.

3. Thomas, p. 97.

4. Thomas, p. 97.

5. Thomas, p. 101.

6. F.W. Beers, Atlas of Orleans County (New York: F.W. Beers and Co., 1878) p. 50.

7. Thomas, p. 212.

8. "Historic Sites and Structures Survey" (on file at Division for Historic Preservation, Agency of Development and Community Affairs, State of Vermont, Montpelier, VT, April 15, 1985).

9. "Historic Sites and Structures Survey".

10. "Historic Sites and Structures Survey".

11. "Dictaphone Bridge Inspection Report Troy Br. 9"(on file in Structures Division of Vermont Agency of Transportation, Montpelier, VT, Aug. 31, 1989). p. 7.

12. "Bridge Report", pp. 7-8.

13. "Bridge Report", pp. 7-8.

14. Orleans County Monitor, 16 Nov 1927, p.1.

15. W. Arthur Simpson, "Solving the Flood Highway Problem" The Vermont Review 2 (1927): pp. 133-34.

16. Matthew Ross and Bruce Clouette, "Vermont Historic Bridge Survey" (Final Report and Preservation Plan on File at Division for Historic Preservation, Agency of Development and Community Affairs, State of Vermont, Montpelier, VT, 1985) p. II-21.

17. Ross and Clouette, p. II-22.

18. Ross and Clouette, p. 11-22.

19. "Bridge Report", p. 7.

20. Ross and Clouette, p. Appendix 6.4.

21. Ross and Clouette, p. II-23.

22. "Bridge Report", p. 7.

23. Ross and Clouette, p. II-24.

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Thomas, Peter A.; Campoli, Gina; Doherty, Prudence; and Peteraon, James,. "Phase I Archaeological Assessment for the Missisquoi Hydroelectric Project". Report No. 34. Department of Anthropology. University of Vermont. 1981.

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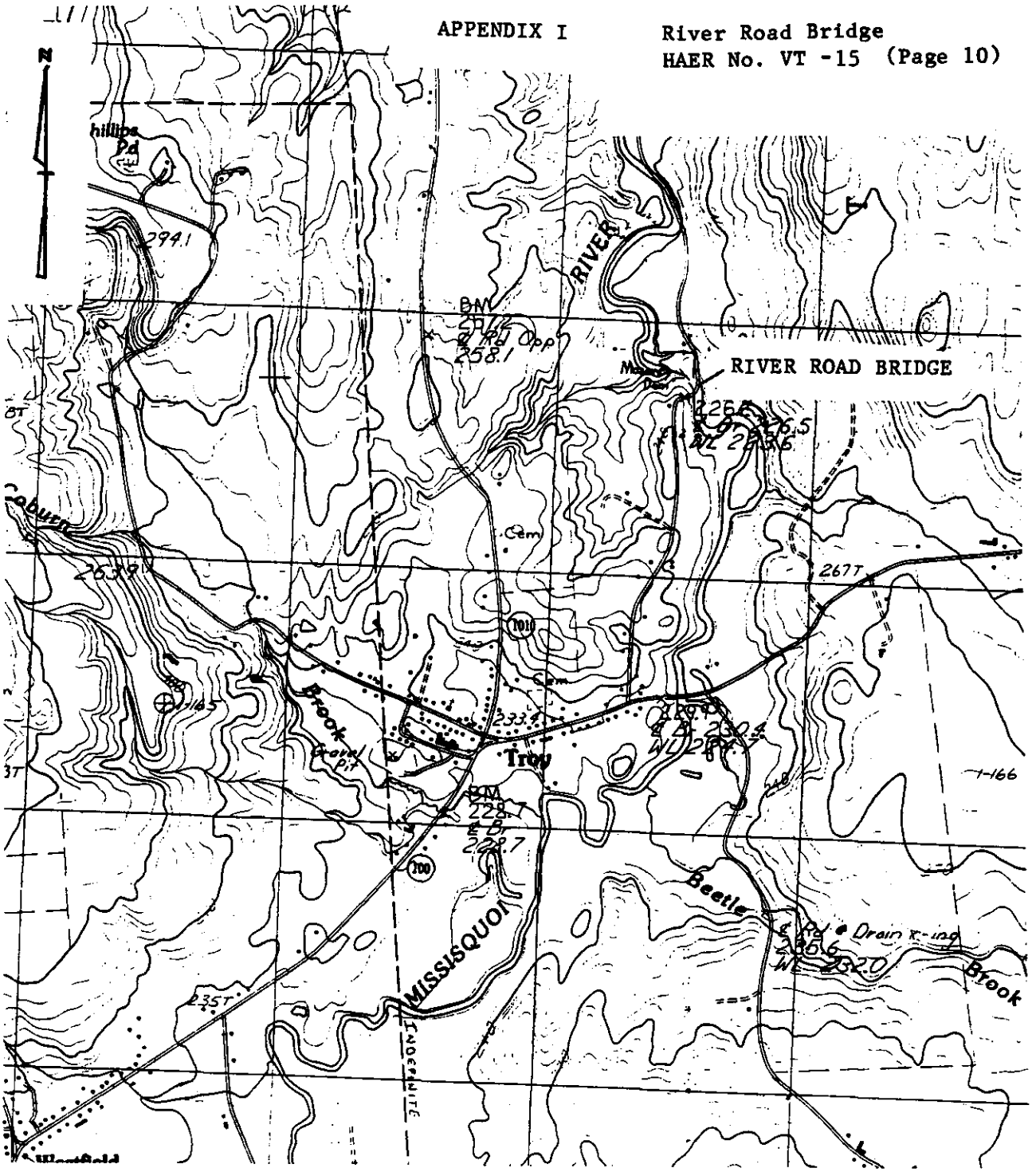
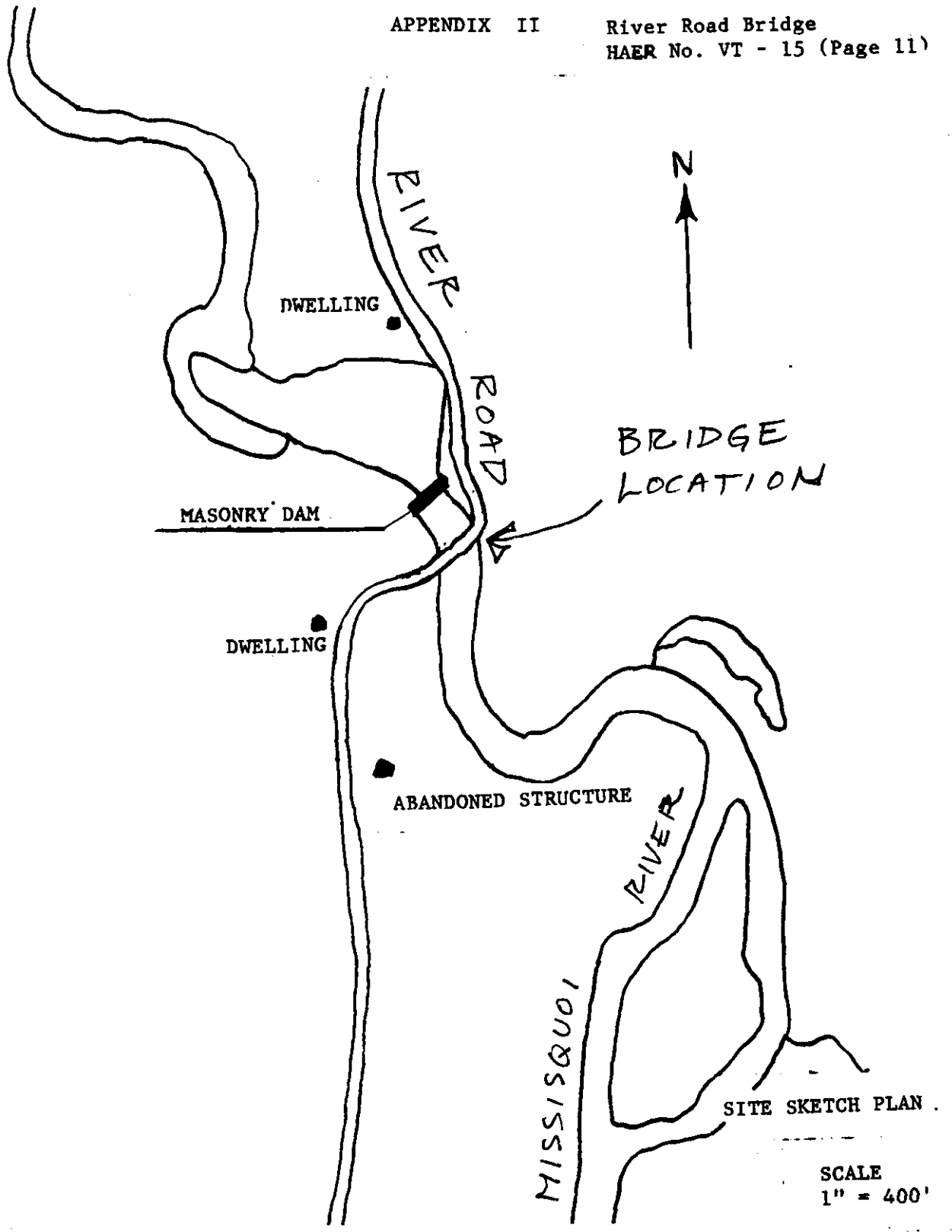


Source: "United States Department of the Interior Geological Survey Map." 1927 North American datum. Reston, VA: Geological Survey, 1986.



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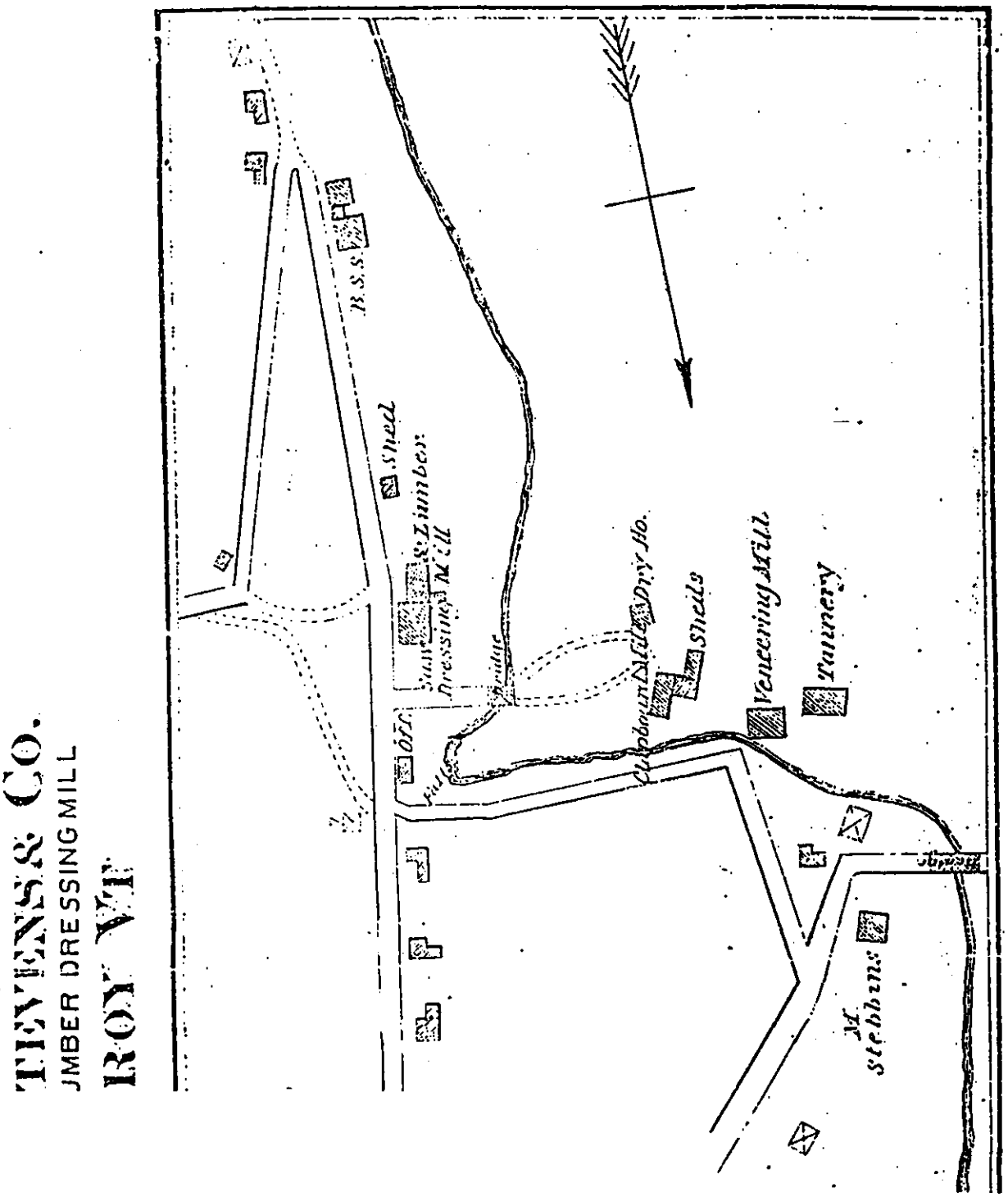

Figure 1. Project area detail as shown on Beers' 1878 map. Area A is located in the area between the river and the structure labeled "office". Area B is across the road, in the area where the saw and lumber dressing mill is shown. Shows crossing as only access to west cluster of buildings.